

WHAT IS CLAIMED IS:

- 1 1. A vertical cavity surface emitting laser (VCSEL), comprising:
2 a first mirror stack;
3 a second mirror stack;
4 a cavity region disposed between the first mirror stack and the second
5 mirror stack and including an active region;
6 a defect source; and
7 a reliability-enhancing layer positioned with respect to the defect source to
8 reduce defect-induced degradation of one or more VCSEL regions.
- 1 2. The VCSEL of claim 1, wherein the reliability-enhancing layer is
2 positioned between the defect source and the cavity region.
- 1 3. The VCSEL of claim 1, wherein the reliability-enhancing layer is
2 positioned within the defect source.
- 1 4. The VCSEL of claim 1, wherein the reliability-enhancing layer is
2 positioned in close proximity to the defect source.
- 1 5. The VCSEL of claim 1, wherein the defect source is disposed
2 between the reliability-enhancing layer and the cavity region.
- 1 6. The VCSEL of claim 1, further comprising a second reliability-
2 enhancing layer separated from the first reliability-enhancing layer by one or
3 more other layers.
- 1 7. The VCSEL of claim 1, wherein the reliability-enhancing layer
2 comprises one or more of the following elements: indium, boron, phosphorus,
3 antimony, and nitrogen.
- 1 8. The VCSEL of claim 1, wherein the reliability-enhancing layer is
2 lattice-matched to surrounding layers.
- 1 9. The VCSEL of claim 1, wherein the reliability-enhancing layer
2 includes one or more strained layers.

1 10. The VCSEL of claim 1, wherein the reliability-enhancing layer
2 includes a superlattice.

1 11. The VCSEL of claim 10, wherein the superlattice is strained.

1 12. The VCSEL of claim 10, wherein the superlattice is lattice-matched
2 to surrounding layers.

1 13. The VCSEL of claim 10, wherein the superlattice is strain-
2 compensated for the surrounding layers.

1 14. The VCSEL of claim 1, wherein the defect source includes an
2 oxidized portion of the VCSEL.

1 15. The VCSEL of claim 1, wherein the defect source includes an
2 implant region of the VCSEL.

1 16. The VCSEL of claim 1, wherein the defect source includes an
2 exposed region of the VCSEL.

1 17. The VCSEL of claim 1, wherein the defect source includes one or
2 more dielectric layers.

1 18. The VCSEL of claim 1, wherein the defect source includes a doped
2 region of the VCSEL.

1 19. The VCSEL of claim 1, wherein the defect source includes a
2 substrate.

1 20. The VCSEL of claim 1, wherein the reliability-enhancing layer is
2 configured to at least in part balance strain created by the defect source.

1 21. The VCSEL of claim 20, wherein the defect source includes an oxide
2 region inducing a compressive strain field, and the reliability-enhancing layer is
3 positioned within the compressive strain field and is characterized by tensile
4 strain.

1 22. The VCSEL of claim 1, wherein the defect source creates a
2 concentration gradient inducing defect migration, and the reliability-enhancing
3 layer is configured to reduce the induced defect migration.

1 23. The VCSEL of claim 22, wherein the defect source is characterized
2 by a relatively high group V vacancy concentration, and the reliability-enhancing
3 layer is characterized by a low group V vacancy diffusion rate.

1 24. A method of manufacturing a vertical cavity surface emitting laser
2 (VCSEL), comprising:

3 forming a first mirror stack, a second mirror stack, and a cavity region
4 disposed therebetween, wherein the cavity region includes an active region;

5 forming a defect source; and

6 forming a reliability-enhancing layer positioned with respect to the defect
7 source to reduce defect-induced degradation of one or more VCSEL regions.

8 25. The method of claim 24, wherein the reliability-enhancing layer is
9 positioned between the defect source and the cavity region.

1 26. The method of claim 24, wherein the reliability-enhancing layer is
2 positioned within the defect source.

1 27. The method of claim 24, wherein the reliability-enhancing layer is
2 positioned in close proximity to the defect source.

1 28. The method of claim 24, wherein the defect source is disposed
2 between the reliability-enhancing layer and the cavity region.

1 29. The method of claim 24, further comprising forming a second
2 reliability-enhancing layer separated from the first reliability-enhancing layer by
3 one or more other layers.

1 30. The method of claim 24, wherein the reliability-enhancing layer
2 comprises one or more of the following elements: indium, boron, phosphorus,
3 antimony, and nitrogen.

1 31. The method of claim 24, wherein the reliability-enhancing layer is
2 lattice-matched to surrounding layers.

1 32. The method of claim 24, wherein the reliability-enhancing layer
2 includes one or more strained layers.

1 33. The method of claim 24, wherein the reliability-enhancing layer
2 includes a superlattice.

1 34. The method of claim 33, wherein the superlattice is strained.

1 35. The method of claim 33, wherein the superlattice is lattice-matched
2 to surrounding layers.

1 36. The method of claim 33, wherein the superlattice is strain-
2 compensated for the surrounding layers.

1 37. The method of claim 24, wherein the defect source includes an
2 oxidized portion of the VCSEL.

1 38. The method of claim 24, wherein the defect source includes an
2 implant region of the VCSEL.

1 39. The method of claim 24, wherein the defect source includes an
2 exposed region of the VCSEL.

1 40. The method of claim 24, wherein the defect source includes one or
2 more dielectric layers.

1 41. The method of claim 24, wherein the defect source includes a doped
2 region of the VCSEL.

1 42. The method of claim 24, wherein the defect source includes a
2 substrate.

1 43. The method of claim 24, wherein the reliability-enhancing layer is
2 configured to at least in part balance strain created by the defect source.

1 44. The method of claim 43, wherein the defect source includes an
2 oxide region inducing a compressive strain field, and the reliability-enhancing
3 layer is positioned within the compressive strain field and is characterized by
4 tensile strain.

1 45. The method of claim 24, wherein the defect source creates a
2 concentration gradient inducing defect migration, and the reliability-enhancing
3 layer is configured to reduce the induced defect migration.

1 46. The method of claim 45, wherein the defect source is characterized
2 by a relatively high group V vacancy concentration, and the reliability-enhancing
3 layer is characterized by a low group V vacancy diffusion rate.